

## Dual-Mode Detection of Heavy Metal Ions Using Plasmonic Sugar Nanoemulsion

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Heavy metals are known to cause environmental pollution and human disease due to their inherent toxicity. However, conventional methods require expensive equipment to rapidly detect traces of heavy metals. Thus, it is required to develop the fast detection method such as colorimetric response. Recently, plasmon nanoparticles have been widely used as probes for colorimetric and label-free detection due to their excellent optical properties. Here, we present a dual mode plasmon method that sensitively and selectively detects metal ions using plasmon sugar nanoemulsion (PSE). PSE probes are synthesized with gold precursors and polysaccharides to introduce optical and targeting functions. Adjust the mixing ratio of the sample and probe according to the color change of the solution to find the optimal conditions. Among various metal ions, a distinct color transition is observed for copper ions. In addition, concentration dependent fingerprint Raman spectra are collected for copper ion mediated assembly. We believe that the PSE probe will help develop heavy metal ion detection.